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ABSTRACT

This pamphlet is the ninth in a series of ten stemming from the view that language is central to learning, that teachers can gain insights into their work and into learning by examining the language of the classroom, and that current language theory can be the means to such insights. The pamphlet describes a project that was undertaken to discover if exploratory talk played a significant role in mediating between science experiences and the solutions to problems in the secondary school. Excerpts from transcripts of student interactions are used to illustrate what the students were able to do with the relevant propositional knowledge at their disposal and the ways in which they explored their understanding of various problems through verbal behavior. (FL)

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Language in the Classroom: A Series. 9

MEDIATING SCIENCE EXPERIENCE THROUGH TALK

R. Southworth

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FOREWORD

This pamphlet is one of a series, produced as discussion papers by a group of teachers who participated in a graduate course in the Department of Curriculum and Instruction at the University of Calgary. In development, the papers reflect the method of the boys of Barbiana: each paper has been shaped and tempered, through several stages by the input of the group. In intent, the series reflects the aims of the pamphlets originated by the Writing Across the Curriculum Project Team of the Institute of Education at the University of London, to whom we are indebted for pointing the way.

The series stems from a view that language is central to learning, that teachers can gain insights into their work and into learning by examining the language of the classroom, and that current language theory can be the means to such insights. Further, the series represents a conviction that teachers are in the best position to understand the heuristic role of language in the classroom as well as to assess the needs of children in the schools and that they are the most likely to find solutions for problems in classroom practice. To realize this potential and to extend their influence, teachers need to offer their ideas and experiences freely and be willing to consider the ideas of their colleagues openly. It is in this spirit of sharing that these pamphlets are published.

We are grateful to Al Kahanoff, Principal of Branton Junior High School in Calgary for his generous editorial assistance and for his help in seeing the pamphlets through publication.

We also wish to thank Miss Lorraine Cockle for the cover design.

James Britton
Merron Chorny

PREFACE

This project resulted from the writer's interest in language and its role in learning which formally began in the Summer of 1975. I became involved in the "Language Across the Curriculum", section of English '75, an Institute held at the University of Calgary. James Britton from the University of London conducted the "Language Across the Curriculum" course. In the winter of 1975-76 I again had an opportunity, under the tutorship of Jimmy and Merron Chorny of the University of Calgary, to formulate my interest to a point where this project has become the beginning of my attempt to apply some current thinking on the matter of language and learning to classroom practice.

R. Southworth

Introduction

It is probably no less true here than it is in England that when students move into secondary school they have much less chance than in elementary schools for exploratory talk. According to the Bullock Committee Report, analysis of lessons can show that class discussion is often no more than a series of disconnected attempts to read the teacher's mind and that there is little chance for genuine thinking by pupils. Much can be done to change the nature of class discussion and to provide opportunities for students to verbally examine and facilitate their thinking through talk. I am proposing the use of small group discussion as a pedagogical technique in problem solving situations. Of primary importance in small group dialogue is the existence of a social situation among peers that is more conducive to talk than the usual classroom discussion. Establishing a setting for classroom discussion to best facilitate learning is a difficult although no less a desirable part of the educational enterprise. For, as Labov¹ contends,

The social situation is the most powerful determinant of verbal behavior and one must enter into the right social relation with a child if he wants to find out what the child can do.

The transcripts of student talk included in this paper provided me with information, that could not have been provided in any other way, about what these students were able to do with the relevant propositional knowledge at their disposal. This is to say nothing of the opportunity for the students to explore their understanding through verbal behavior.

¹W. Labov, The Logic of Nonstandard English, Georgetown Monographs on Language and Linguistics (1969) 22, reprinted in Language in Education, Rutledge and Keagan Paul (London), 1972, in association with the Open University Press.

According to George Kelly,

Behavior presents itself as man's principal instrument of enquiry. Without it his questions are academic and he gets nowhere. When it is prescribed for him he runs around in dogmatic circles. But when he uses it boldly to ask questions, a flood of unexpected answers rises to tax his utmost capacity to understand. ²

Through talk we have the opportunity to deal tentatively with our ideas. In this engagement, expressive language has an important role.

Expressive language is

. . . close to the speaker. It relies upon a reader's interest in the writer as well as in what he has to say. Because of these qualities it has great educational importance, since it provides the tentative stage through which a pupil's new thinking must pass on the way to the comparative certainty of knowledge. ³

This is not to imply that the function of talk is limited to its value for the tentative formulation of one's knowledge. As Martin points out

We can't really be said to know something until we've made it a part of our way of thinking and explored its implications for related areas of knowledge. ⁴

In reference to the transcripts included, one may question the significance of an understanding of the Mexican jumping bean in the cosmic scheme of things, but that is to overlook the point.

Subject language, particularly in science, is very specific and efficient, based on hypothesis and definition. It is developed to get the

²George Kelly, "Behavior is an Experiment," Bannister, D. (Ed) Perspectives in Personal Construct Theory, p.260.

³Bullock Report, ch. 11, p.165.

⁴Nancy Martin, From Information to Understanding: What Children Do With New Ideas, London: University of London Institute of Education, 1973, p.12.

business at hand accomplished, and to communicate as efficiently as possible the body of acquired knowledge and to share on-going developments.

In his analysis of classroom language, Dennis Searle suggests,

If the person first attempts to express new experience in transactional or poetic language he is apt to find himself working with a double burden, the need to understand the experience and the need to develop a more formal mode of language.⁵

The difficulties that can arise from an early introduction of "scientific jargon" for which students have not established meaning are at least partially alleviated by the small group dialogues which can later be followed up by the introduction of terminology. Britton has put the point very plainly:

Allow students to use their terms. Introduce yours. Allow them to use their terms to come to grips with yours. And arrive eventually at where you want to go.⁶

Too often in science, language is regarded as merely a vehicle for communication. Sapir⁷ suggests that "language is primarily a vocal actualization of the tendency to see realities symbolically" and on the same point contends that ". . . language is highly relevant to situations which are not obviously of a communicative sort". The point Sapir is making here coincides with Vygotsky's view that language is the point at

⁵Dennis Searle, Analysis of Language Activities in the Classroom, M.A. Thesis, University of Calgary, 1973, p.17.

⁶James Britton, English '75, University of Calgary, 1975 - from notes.

⁷Sapir, Edward (1961), Culture, Language and Personality, University of California Press, Berkeley and Los Angeles.

which thought and speech merge and is the vehicle for the intellectual activity of rational adults. It is the intersection, as it were, of language and thought that results in word meaning. The development of language as an intellectual tool is, he states, in a most critical stage during adolescence.

In teaching mastery of subject language, perhaps we too often assume that if students "limp around long enough in someone else's language they may eventually learn to walk in it". In order to elaborate on Britton's point and to offer further basis for the type of student learning activity suggested here, the following is quoted from a Times Educational Supplement summary of the Bullock Committee Report:

In secondary schools, with their subject-oriented work, many teachers regard language development to be outside their concern. While many teachers recognize that their aim is to initiate a student in a particular mode of analysis, they rarely recognize the linguistic implications of doing so. Talk is a valuable means of learning, but good class discussion cannot be had on demand: it must be built on work in small groups. And expressive writing finds no place at all in many subjects. Children are not asked to produce the kind of writing that will help them arrive at conclusions.⁸

The Activity

The activity described here was an attempt to discover something about the role exploratory talk can play in learning. The physical principles involved in the solutions to the rather novel situations the students were asked to deal with in the activity had been dealt with

⁸ Times Educational Supplement, February 21, 1975.

previously both in the classroom and the laboratory. The students' laboratory experiences with these principles had been "hands on" type of activities. That is, they had been experiments related to ideas taught and discussed in class, intended to involve students in active discovery and done by the students working in groups of two or three.

Thus, the students were assumed to "know" the physics involved before participating in the activity described in this paper.

The intent of the activity is embodied in this question: Can exploratory talk play a significant role in mediating between science experiences and the solution to problems? Underlying the activity was this view:

Passive learning is a happily discredited idea but it is important to realize that the 'active' in 'active learning' refers less to finding information for yourself than to what you do with it when you have found it.

One of the ways in which we use new information is to tentatively reformulate ideas, and to develop tentative hypotheses leading to solutions to problems through verbal interaction.

The students, working in pairs and using a tape recorder were told to attempt to work out a solution, verbally, to one or two rather novel problems. Essentially they were to apply principles of physics, which they had studied, to new situations. They were instructed to begin their dialogue by one of them reading the problem. Here is the transcript of the dialogue between Bruce and Dave:

Bruce: A man is in a bathtub full of water. The tub is on a car, which is at the top of an inclined plane. There is negligible friction.

The car is released and of course there is some sloshing as it starts down, but after the sloshing has subsided, assuming the plane is a long one, what will the surface of the water be parallel to? The surface of the earth? The inclined plane? Your turn.

Dave: I think, if you'll recall that uh, uh, frames of reference thing, that...the...if you look at it in one way, once the bathtub has accelerated to where, uh, the friction and the acceleration give it, you know, work together, to give it'..

Bruce: Reach terminal velocity.

Dave: Yeh, steady velocity like, you know, a man falling through the air, once it gets to that then it will be as if it wasn't moving at all; it would just...

Bruce: Yeh, but it's always going to be accelerating...

Dave: No, not...

Bruce: ...because there's no friction.

Dave: Not - no friction!

Bruce: Or is it almost?

Dave: It says negligible. So that means there's no friction.

Bruce: Yeh, but what about...

Dave: So that means its no...gonna re...

Bruce: Air friction though.

Dave: Oh, say...if we say, if we assume there's no friction...
if we assume there's no friction...

Bruce: It's always going to be accelerating.

Dave: I don't think...I don't think it'll be parallel to the plane though. I think it'd be...

Bruce: It'll be somewhere in between.

Dave: Yeh, it'll be. It's trying to be parallel to the earth 'cause it's all being...

Bruce: Yeh!

Dave: Pulled down, but the acceleration...

Bruce: If it was stopped accelerating.

Dave: Well, no, wait a second, wait a second, we gotta think about it.

Bruce: No.

Dave: It's accelerating due to the earth's pull on the water itself; it's not accelerating because there's a jet pack in the back of it, so...uh...the earth's pull's going to be pulling on every molecule of water. I would say the surface would be parallel to the earth's surface.

Bruce: Yeh, but when the thing starts though, eh.

Dave: When the thing starts, it starts to slosh.

Bruce: The water's like this, but when it goes down, when it goes down...
I don't know. Yeh, I think that's...

Dave: I think the water'll pretty well stay parallel to the surface of the earth all the time.

Bruce: Yeh.

Dave: It'll you know, slosh.

Bruce: Except when the acceleration is right at the beginning, when it's really great, then...

Dave: Why is the acceleration really great at the beginning?

Bruce: 'Cause the waves...it rebounds off the side.

Dave: That doesn't make the acceleration any greater.

Bruce: No, I never said it...no. It accel...oh, yeh, that's right, without friction.

Dave: I wish that guy'd get out of the bathtub; it makes it so hard to think.

Dave: O.K. Uh...

Bruce: As long as there's no friction. 'Cause friction'd be the force that counteracts it, eh?

Dave: Right.

Bruce: Which would change it. Which would change the acceleration.
(silence) As it's decelerating, eh, it's gonna be...you know, the water's gonna want to go towards...you know, the force that it's decelerating with...I don't know what I'm saying.

Dave: I agree - because ya-ya you...you've got to keep remembering that the force of gravity isn't...you know, it's not like most other forces. It doesn't push on just a portion of the what's...of what's being accelerated; it pulls on everything.

Bruce: Yeh. It's just parallel to the surface of the earth.

Dave: Oh, O.K.

The boys do talk their way to a solution. What occurs in a situation of this kind has been put in this way:

...dialogue has obvious strengths. Each participant continually forces the other to articulate what he thinks, to cope with awkward facts or arguments, to illustrate and exemplify, to operate on ground not of his own choosing: there is never any problem of what to say next, because if one is silent the other will

... speak; there is instant feedback which tells you whether you have made yourself clear and presents you with other relevant⁹ considerations which you have so far not taken into account.

There can be, however, some limitations to the dialogue: the scope of the interaction may not be sufficient for an expansion of ideas. A student who is timid or overly tentative may be excluded from participation in the discussion. One student may divert, or cut off another's promising input at a point when the latter was setting a direction which might have enabled all to come to grips with the matter at hand.

The transcript nevertheless, contains some excellent examples of features of dialogue or exploratory talk in the learning process.

The dialogue is sustained partly because each senses discrepancies between his own and the other's knowledge and they force each other to spell out implications and articulate assumptions.¹⁰

As one follows through the conversation, there appears to be a growing commitment to the topic as the boys talk. On the other hand, particularly toward the end of the conversation, they equally seem to be

...driven by the discomfort of seeing inconsistencies in their two views of 'how it is' and by a pleasure in working out 'how it must be'. Dialogue, once under way may, it appears, become a self motivating activity.¹¹

In this context, two important features of dialogue are illustrated in a segment of the transcript, early in the conversation. Both relate to the heuristic function of talk:

⁹From Information to Understanding, The Schools Council and London University Institute of Education English Dept., 1973 and 1973.

¹⁰Ibid.

¹¹Ibid.

Dave: ...if you look at it in one way, once the bathtub has accelerated to where, uh, the friction and the acceleration give it, you know, work together, to give it...

Bruce: Reach terminal velocity.

Dave: Yeh, steady velocity like, you know, a man falling through the air, once it gets to that then it will be as if it wasn't moving at all; it would just...

Bruce: Yeh, but it's always going to be accelerating...

Dave: No - not -

Bruce: ...because there's no friction.

Dave: Not - no friction!

Bruce: Or is it almost?

Dave: It says negligible, so that means there's no friction.

Both features have been articulated by the London Writing Across the Curriculum Team:

...the student discovers implications in new information which affect what he thought before. And he discovers them only as he talks almost as if tripping over them. ¹²

It is in the act of articulating what he thinks that he realizes what is implied in the new information. ¹³

Karen's and Val's conversation regarding the same problem is quite different from that of Bruce and Dave:

Karen: A man is in a bathtub full of water. The tub is on a car, which is at the top of an inclined plane. There is negligible friction. The car is released and of course there is some sloshing as it

¹² Ibid.

¹³ Ibid.

starts down. but after the sloshing has subsided, assuming the plane is a long one, what will the surface of the water be parallel to? The surface of the earth? The inclined plane?

Val: Well, first, do you...that, uh...I thought it could be parallel to the ground.

Karen: To the earth.

Val: Yeh, to the earth.

Karen: I think I thought it'd be parallel to the inclined plane.

Val: Why? The first...the first is that...the first assumption, uh...

Karen: Yeh, just...yeh, first assumption.

Val: Then when you think about...if you think about something on its side, or a...a beaker of water tilted, you know that is going to be parallel with the earth...the surface of the water.

Karen: If, if you have a beaker of water, full of water.

Val: Uh huh.

Karen: Going down a plane the beaker is tilted but the water stays parallel with the earth, right?

Val: Yeh.

Karen: So this would...oh, I see your point now.

Val: But then if you, uh...when...if you think about the velocity of the beaker or the...or of the car, the car is speeding up and you...the...the theory of or...inertia, where, say, if you're in the car and the car's going quickly - fast - and it suddenly stops, you keep going.

You're...because...your inertia...Wouldn't you say that if you think about the velocity of the car and the fact that if you're

in a car and it stops suddenly, you're thrown forward because the force that is acting on the car is not acting on you and if it starts suddenly you're left behind? So wouldn't you say that if the...if the car is accelerating down this...plane because it's a long one...

Karen: Uh huh.

Val: ...that the water would be left behind, sort of, and be bunching up up towards the back of the tub?

Karen: The water would be left behind, but that doesn't answer the question what will the surface...

Val: No - no but if it's left behind...

Karen: ...uh - the water be parallel to.

Karen: Uh huh

Val: As it accelerates, it...wouldn't it leave a slant in the water? Sort of if the water's bunching up towards the back of the...

Karen: So you think that the surface of the water is parallel to the surface of the inclined plane.

Val: Yeh, because the car is accelerating.

Karen: Accelerating.

Val: So as long as it's accelerating, the...the iner,...the inertia of the water... The...the work force of gravity working against the ...the force of the inertia would balance it out and cause it to be level with the inclined plane.

Karen: Level with the inclined plane?

Val: Parellel to.

Karen: Parallel to? Because I don't see how the water could be pushed

back, like, how you say...like you're giving the example of a person in a car. The man in the bathtub might be left behind, like pushed back, but I don't see how the water could.

Val: Well the force.

Karen: Because the wa...because of the force would push...keep it...and keep it there.

Val: Right.

Karen: O.K. So the force is keeping...is what you say keeping the water back, pushing it back?

Val: And then...and then the force of gravity is levelling it out. So instead of being level with the earth, it is level with the inclined plane. The two working together.

Karen: Uh hu, uh hu...

Val: Cause it to be level with the inclined plane.

Karen: O.K.

In her discussion with Karen, Val applies an idea to the situation very early which in fact gets her the correct answer:

Val: Then when you think about...if you think about something on its side, or a...a beaker of water tilted, you know that it's going to be parallel with the earth...the surface of the water.

Karen: If, if you have a beaker of water, full of water.

Val: Um huh.

Karen: Going down a plane the beaker is tilted but the water stays parallel with the earth, right?

Val: Yeh.

And Karen agrees with her:

Karen: So this would...oh, I see your point now.

Then Val seems to think that she has not taken everything into account and continues the dialogue to introduce the motion of the car. The dialogue is sustained, eventually leading to the incorrect answer to the question. The conversation, however, is much more than 'wrong' learning and a pooling of ignorance. Talk is the natural vehicle for the first draft of our ideas, full of stumblings, false starts, half finished sentences:

Getting hold of information is not such a simple operation as is implied by that expression (or its equivalents - 'acquiring concepts', 'grasping' ideas, etc.) Information is not just taken on like cargo. ¹⁴

In their talk, the girls have at least explored some of the dimensions of their knowledge and brought it to bear on the problem. If they had simply been told the correct answer by the teacher, there would not be assurance that they understood the problem, perhaps even to the extent that they have tried to understand it in this instance. Of course, they would not be and were not left at this stage. The teacher, too, is a factor in relation to group talk. The following is a transcript of Karen's and Val's joint attempt at another problem:

Karen: A Mexican jumping bean is a bean which is hollow and in which there lives a live insect. The exterior of the bean is hard and rigid, so that the bug cannot transmit any movement to the outside world by flexing the bean's wall. Once in a while the whole bean

¹⁴ Ibid.

is seen to jump up a short distance (perhaps a millimeter) above the table top on which it has been resting. This evidently does not contradict the law of conservation of momentum because it does happen. How can the bug do it?

It's the momentum before equals the momentum after, isn't it?

Val: Right.

Karen: So, I would say that if the little bug inside the bean suddenly jumped up, something has to move. Like...something...like if it ...O.K., that's its momentum, right?

Val: Right, its velocity.

Karen: So, something else...

Val: Its velocity and its mass...

Karen: Uh huh

Val: ...must move the...the bean.

Karen: ...the...right.

Val: But then it only moves such a small distance because the force of gravity attracts it back.

Karen: Right, O.K. It doesn't...it doesn't...like, it's not moving around inside and then it builds up to move the bean. Does it?

Val: No, no.

Karen: It just...if it...it has momentum in one direction, there must be momentum...another momentum?

Val: No, it...when the...when two objects meet...

Karen: Un hu.

Val: ...the...ah...the momentum of each ob...or the momentum before, of each object, before they meet, has got to be - total...has got

to equal the momentum after.

Karen: The momentum of each object?

Val: So the, ah...the little...the bug jumping up and hitting its head on the...

Karen: Uh huh.

Val: ...roof of the bean...? I don't know...and, ah...

Karen: That's the momentum before.

Val: Right.

Karen: And, ah...

Val: The actual momentum of the bean is zero.'

Karen: Right.

Val: And so they hit and the bug is stopped - supposedly.

Karen: Right.

Val: . And the bean keeps going.

Karen: Right - O.K.

This transcript seems to me an example of the role of talk in making a bit of knowledge one's own. One might ask: What new knowledge was generated through talk between Karen's very succinct question at the beginning, and her position at the end of the conversation? Here, again, it is apparent that through articulating their ideas the girls realize what is implied in each new bit of information. The implications are discovered as they talk. The talk, besides serving as the means of communication is also the heuristic instrument. Certainly, many of us "chew-over" ideas while we think; however, we should provide an opportunity for those who don't do so through language. The relation between language and thought is intimate:

Man interposes a network of words between the world and himself, and thereby becomes the master of the world.

Georges Gusdorf